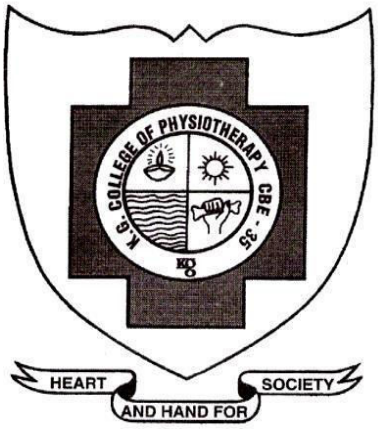
EFFICACY OF AEROBIC INTERVAL TRAINING ON IMPROVING ENDURANCE CAPACITY AND QUALITY OF LIFE AFTER CORONARY REVASCULARIZATION



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ELECTIVE : PHYSIOTHERAPY IN CARDIO-RESPIRATORY

A DISSERTATION SUBMITTED TO THE TAMILNADU

Dr. M. G. R MEDICAL UNIVERSITY, CHENNAI

AS PARTIAL FULFILLMENT OF THE

MASTER OF PHYSIOTHERAPY DEGREE

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CERTIFICATE

Certified that this is the bonafied work of **Mrs. RESHMA MENON** of K.G. College of Physiotherapy, Coimbatore submitted in partial fulfilment of the requirements for Master of Physiotherapy Degree course from the Tamil Nadu Dr. M. G. R Medical University under the **Registration No : 271730183** for the May 2019 Examination.

Date: Principal:

Place: Coimbatore

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A Dissertation on

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Internal examiner **External examiner**

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I INTRODUCTION

Coronary artery disease (Myocardial infarction (MI)) occurs when there is a diminished blood supply to the heart caused due to atherosclerosis and occlusion of an artery by an embolism which leads to irreversible necrosis and myocardial cell damage.

Type of coronary artery disease is been classified according to the area affected-

- Anterior wall (septal) MI- Obstruction of left anterior descending artery.
- Posterior/lateral wall MI- Obstruction of circumflex artery.
- Inferior wall MI- Obstruction of right coronary artery.

Coronary artery disease (CAD) is the main cause of death worldwide and society ranked as first cause of death in India and one of the leading cause of disability, cardiovascular disease is identified as either an acute or chronic cardiac disability resulting due to reduction or arrest of blood supply to myocardium with associated coronary arterial disease. In 2012 coronary heart disease lead to 1.46 million deaths. (Viviane2011)

Chronic evaluation of blood pressure, blood lipid disorder, physical inactivity and decline in functional capacity remain the major modifiable risk factors for coronary artery disease.

The most common symptom of coronary artery disease is angina which described as feeling of heaviness, burning sensation and of fullness feeling. It is usually felt in the chest and may be felt in the left shoulder, arm or jaw. Other symptoms include shortness of breath, palpitation, weakness or dizziness, nausea and sweating. Treatment of CAD involves making lifestyle changes, medications, possibly undergoing invasive/ surgical procedures.

Cardiac rehabilitation is long term program that involves prescribed exercise, education and counselling to limit psychological effects of cardiac disease and to enhance the psychosocial and vocational status of selected patients. Cardiac rehabilitation starts in the hospital, before discharge and also continues after discharge, in a supervised setting and transitions to a home based program to be continued indefinitely. According to the literature available, exercise training forms the core component of cardiac rehabilitation in patient with coronary artery bypass graft (CABG) surgery and the positive effects have been studied extensively. Historically, the primary focus of most cardiac rehabilitation exercise programs has been aerobic activities. However over the past decades strength (or resistance) program has been incorporated into rehabilitation programs. (Martin k. kiel 2011)

In 2004, a systemic review and meta analysis revealed that exercise-based cardiac rehabilitation reduced cardiac mortality and triglycerides level and systolic blood pressure. But there were no significant changes in high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) levels and diastolic blood pressure in coronary artery disease patient. (Taylor RS, brown, Ebrahim S et al.2004) .

In multi-centric prospective study by (Meurin) early exercise training has shown to increase in an exercise based cardiac rehabilitation program after CABG. Assessment of lung functions becomes an important factor post operatively. Also the intervention needs to be targeted according to the post operative complications like air way clearance techniques or strengthening the respiratory muscles etc. Aerobic interval training reserves weakness and improves endurance.(bisset 2015)

Literatures detailed that application of anesthesia combined with supine lying position results in an upward shift of the diaphragm, relaxation of the chest wall, altered chest wall compliance. All this factors results reduced respiratory muscle strength and significant lower post operative endurance capacity (horstkote). Patients often suffer from psycho-emotional symptoms, such as depression, anxiety. The pain after surgery reduces endurance capacity results in poor quality of life in individuals who undergone CABG .

Assessment of quality of life using self- reported questionnaire is a way to evaluate and explore the psychological experience of patient with heart problems. The original version of the MacNew questionnaire (DixonT, lim LL,OldridgeN 2002) is a diagnostic tool comprising multiple choice questions.

Patients are instructed to check only one out of seven possible answers each marked with a check box and are unable to select more than one answer for each proposed questions for computation of the final score. Global and subscale scores are computed by dividing the sum of the scores achieved for each individual item by the number of items listed in the questionnaire.

Six minute walk test (6MWT) has become one of the most popular clinical exercise test for evaluating functional capacity. It is a practical and low cost test, that can be applied in different ages and body mass index and provide the exercise capacity of patients to perform routine activity or task. The 6MWT is a sub maximal exercise test for evaluating physical functional capacity. Suggest that 6MWT is feasible and well tolerated in adult and older patients, shortly after uncomplicated cardiac surgery and provides reference values for distance walked after cardiac surgery. (Fiorina1998 and Paul I enright, et al. 1998)

The distance that a patient can walk on a flat surface in a period of 6MWT may be used either as a generic one time measure of functional status or as an outcome measure for rehabilitation program. Assessment of functional capacity is an

Integral part of the clinical management of in post CABG patient.

Exercise therapy has long been used for rehabilitation purposes and benefit of regular physical exercise is also well established. The intensity of aerobic exercise training is a key issue in cardiac rehabilitation programs. Endurance Aerobic training is typically performed as continuous training at moderate to high exercise intensity in steady state conditions of aerobic energetic yield.

However interval training has been proposed to be more effective than continuous exercise for improving exercise capacity. (Sara maldonadoaug 2016)
The interventions are often based on the deterioration of Aerobic capacity that results from the progressive hemodynamic consequences in myocardial infarction patients.

(Mark and Madhani k et. al 2015) suggested that improved accessory respiratory muscle function in the mechanism responsible for the increased endurance capacity observed in post CABG patient performing 6MWT.

The MacNew heart disease health related quality of life questionnaire is now available as a self administrated instrument. (Valenti L, Lim L, Heller RF, 1996),The MacNew is designed to evaluate how daily activities, presented as physical limitation and emotional and social functioning sub scales and a global scales are affected by CAD and its treatment . (Hofer S, Lim L, Guyatt G , Oldridge N, 2004) .The items and scales are scored from 1 (low HRQOL) TO 7 (High HRQOL) and minimal important difference on each MacNew scale is 0.50 points. (Dixton T, Lim L, Oldridge N. 2002). The reliability level of the English MacNew has been established

to be an average between the fifth and sixth grade level. (Gromosk A, oldridge N, 2011)

For health promotions, patients with CAD are recommended to regular exercise at intensities ranging from 40-90% of VO_2 peak.(American college of sports medicine) . However aerobic exercise training programs are most often carried out at low to moderate intensities**.** (Swain D P, Franklin B A 2002)**.** Several studies have shown a significant inverse relationship between participation in rehabilitation program involving exercise and reduced progression of CAD.

(Froelicher v, Jensen d 1984) large cohort studies found that however higher intensity of physical activity was related to reduced risk, as reflected by an inverse association between exercise intensity and coronary heart disease incidence in men. (LeeI Msesso h d, Oguma y 2003).

Previously there was only limited information regarding the effect of Aerobic interval training after CABG surgery on endurance capacity and quality of life. However, study on influence of Aerobic interval training in individuals are very less. Hence, there was need to study out the efficacy of Aerobic interval training and conventional cardiac rehabilitation on endurance and quality of life after Coronary Revascularization.

1.1 NEED FOR THE STUDY

Coronary heart disease is a significant health problem all over the world. Coronary artery disease commonly affect the coronary arteries of the heart. Coronary heart disease accounts approximately 50% of the cardiovascular disease deaths in women.

Younger patients had lower post operative vital capacity than older patients. Various studies revealed that there is change in quality of life in CABG patients. Patients often suffer from psycho emotional symptoms, such as depression, anxiety. CAD has been associated with decrease in the exercise in tolerance which results in impaired activities of daily living and functional activities which ultimately leads to impaired quality of life. (Horstkotte 2008)

Hence, assessment of lung function becomes an important factor post operatively. Also the intervention needs to be targeted according to the postoperative complications like airway clearance techniques or strengthening the respiratory muscles, etc. The evidence suggests that some interventions recently used in physiotherapy may be no benefit to patients undergoing uncomplicated open heart surgery (Patman S, 2001).

Apart from conventional physiotherapy treatment, aiming to re-establish endurance capacity and quality of life, some strategies should be used, such as aerobic interval training, which improves endurance capacity (Hulzebos et al., 2006).

A few studies were done on Aerobic interval training protocol for coronary artery bypass graft. So, more investigations are needed to know its effect in regular care of patients who have undergone CABG procedure, therefore the need for this study and the study was undertaken.

1.2AIM OF THE STUDY

- To investigate the efficacy of Aerobic interval training on endurance capacity and quality of life after Coronary Revascularization.

1.3 OBJECTIVES OF THE STUDY

- To study the effect of Conventional cardiac rehabilitation on endurance capacity and quality of life after Coronary Revascularization.
- To study the effect of Aerobic interval training on endurance capacity and quality of life after Coronary revascularization.
- To analyze the effect of Aerobic interval training along with Conventional cardiac rehabilitation on endurance capacity and quality of life after Coronary Revascularization.

1.4 HYPOTHESIS

1.4.1 NULL HYPOTHESIS

- There is no significant difference in the effect of Aerobic interval training on improving the endurance capacity and quality of life after coronary revascularization.

1.4.2 ALTERNATIVE HYPOTHESIS

- There is a significant difference in the effect of Aerobic interval training on improving the endurance capacity and quality of life after coronary revascularization.

1.5 KEY WORDS

- Aerobic interval training
- Conventional cardiac rehabilitation
- Endurance capacity
- Quality of life
- six minute walk test (6MWT)
- MacNew questionnaire.

II REVIEW OF LITERATURE

American heart association guideline 2008

The guideline found during the past two decades, major advances have occurred in diagnostic techniques, the understanding of natural history, and interventional cardiology and surgical procedures for patients with coronary heart disease. These advances have resulted in enhanced diagnosis, more scientific selection of patients for surgery or catheter-based intervention versus medical management, and increased survival of patients with these disorders.

Reid 2006

Education consisting of postoperative precautions of CABG (wound care and temporary restrictions in physical activity), exercise guidelines (including frequency, intensity, time and type of exercises and red flags), general CAD pathophysiology and risk factor modification was done by physiotherapists in the acute care setting. This is commendable because the motivation of patients with CAD to be active appears to be greatest in the early post-discharge period.

Sema Savci 2011

Coronary artery bypass graft (CABG) surgery is performed commonly on patients with coronary artery disease. Despite advances in anaesthesia techniques, CABG frequently leads to postoperative pulmonary complications. Respiratory complications after CABG surgery include alterations in pulmonary function and gas

exchange, reduced cough and may be associated with atelectasis and sputum retention .

Hirschhorn 2008; Pryor and Prasad et al 2008

Activity based interventions such as circulatory exercises and/or graded mobilization were commonly used by physiotherapists in this study. These interventions are supported by evidence in the literature. Early mobilization in hospital is encouraged following CABG surgery and acute coronary events if patients are medically stable (Hirschhorn et al 2008; Pryor and Prasad 2008). In the majority of articles mentioned thus far the patients were mobilized out of bed on day one post surgery and mobilisation progressed gradually.

Departments of Physiotherapy and Thoracic Surgery, Orebro Medical Centre Hospital, Sweden 2001

Elisabeth Westerdahl done comparative study on three different deep breathing techniques after coronary artery bypass graft, where 98 patients were selected on the basis of inclusion, exclusion criteria and the techniques examined were deep breathing with blow bottle device, an inspiratory resistance positive expiratory pressure mask and performed with no mechanical device.

Pulmonary function and retrogenological changes were evaluated. four days post operatively there were significant decrease in pulmonary function, and no major differences found between the treatment groups, but impairment in pulmonary function tended to be less marked using blow bottle technique.

Freitas 2007

With reference to non-pressure related Deep Breathing Exercise , the effect of Incentive Spirometry was compared to other prophylactic physiotherapy techniques on postoperative pulmonary complications (PPC) following CABG in a Cochrane review. A total of four randomized controlled trials met the inclusion criteria for this review. The reviewers found no differences in PPC when using IS or a pressure device such as IPPB for patients after CABG surgery.

Marte Volden 2009

The high-intensity exercise in the AIT group was set to 90% of Hf_{max} and was performed as AIT because this training method has previously yielded the greatest improvements in aerobic capacity over a relatively short time in healthy individuals, and in patients with coronary artery disease, intermittent claudication the metabolic syndrome and post-infarction heart failure. The rationale behind interval training is that most evidence suggests that it is the pumping capacity of the heart (i.e. stroke volume) that limits $\dot{V}o2max$, and the interval design allows for rest periods that make it possible for the adolescents to complete short work periods at higher intensities, which thereby challenge the heart's pumping ability more than what would be possibly continuous exercise.

Dominique Hansen 2011

Aerobic endurance training is an important treatment modality in the rehabilitation of revascularized coronary artery disease (CAD) patients, and has been shown to result in significant increases in peak oxygen uptake (VO2peak) . A reduced mortality risk in patients with CAD is, at least in part, related to an improvement in VO2peak. Thus, rehabilitation programs significantly reduce cardiovascular mortality in these patients. International guidelines have therefore been published, in which aerobic endurance training is the basic component of exercise intervention.

Mahmoud nikseresht 2014

This is to compare the effects of Non linear resistance training and aerobic interval training on inflammatory markers in sedentary men who are obese. In this study, the non linear resistance training and aerobic training programs were equally effective at reducing insulin resistance , fasting insulin levels, fat mass, and waist circumference. There were no significant changes in serum IL-10, IL-20, and TNF-α ratio was significantly increased with aerobic interval training when compared with the control condition.

Trine moholdt 2011

As exercise capacity predicts the survival in coronary heart disease patients, it is warranted to increase or maintain peak oxygen uptake after myocardial infarction.

High intensity aerobic interval training has proven more effective than continuous moderate intensity exercise at increasing VO_2 max in coronary heart disease patients. We have found VO_2 to increase more after treadmill aerobic interval training than usual care exercise training in myocardial infarction patients.

Viviane M. Conraads 2015

Exercise training is a cornerstone in cardiac rehabilitation; however, there is still controversy regarding the exercise characteristics that are most effective for improving peak VO_2 in CAD patients. Proof of concept papers comparing Aerobic interval training and Moderate Continuous training were conducted in small sample sizes and findings were inconsistent and heterogeneous . The results of the present large randomized multicentre study in coronary artery disease patients demonstrate that aerobic interval training and aerobic continuous training are equal in improving peak VO_2, peripheral endothelial function, Quality of life , and some cardiovascular risk factors. In addition, both programs seem to have beneficial effects within the first 6 weeks of training and are safe in CAD patients.

Cristina Opasich 2004

The author recommend that soon after a cardiac surgery procedure, a patient is prescribed an individual rehabilitation program based on his or her demographic, clinical, psychological, and functional variables. In this perspective, early execution of the 6-min walking test (6MWT) can be useful.

The 6-min walking test is a practical, simple test, which requires only the ability to walk; its use can be extended to frail and limited patients.

The distance that a patient can walk on a flat surface in a period of 6 min may be used either as a generic one-time measure of functional status or as an outcome measure for the rehabilitation program. The results of the 6-min walking test are generally interpreted as a percentage of predicted values in healthy subjects. However, a correct interpretation of the 6-min walking test in a given patient can only be achieved by comparing that patient's 6- min walking test performance with appropriate reference values for the specific population from which the patient comes: the higher the affinity of the patient with the reference population, the lower the risk of approximation in the interpretation.

Enright and Scherril et al (1998)

The results of the 6MWT are given as absolute value in meters and as a percentage of the predicted value, taking into account anthropometric variables (age, sex, weight and height) according to the reference equation proposed by healthy subjects . The effects of the cardiac rehabilitation program were evaluated as a percentage of increase in the distance walked between the two tests.

Cooper KH, Wright DJ et al 2001

There is maximum correlation in the rehabilitation equivalent value when compared to rate of perceived exertion suggesting that the six minute walk test is more a sub maximal exercise test, and hence can be considered as the exercise testing procedure in cardiac rehabilitation setup.

The reliability of test in healthy elderly person and patients were high and it has been establish as a valid and reliable test to asses the exercise capacity of various patient groups.

Elayne Kelen 2009

In this study, author could observe reduction of volumes and lung capacity after coronary artery bypass grafting and/or valve replacement, in addition to significant negative correlation only of the ambulation ability on the fifth postoperative day with the length of postoperative hospital stay of these patients. The early ambulation in heart surgery has been correlated with reduction of morbidity and pulmonary complications, which can consequently reduce the length of hospital stay.

The significant correlation of FVC and FEV1 with the 6-MWT also suggests that ambulation ability may better reflect overall functional capacity and can be justified by the fact that greater ambulation capacity is associated with higher stimulation of ventilation, increased pulmonary perfusion and detachment of secretions and oxygenation improvement.

Maes S 2008

Patients either with angina or ischemic heart failure demonstrate that the English version of the MacNew meets the psychometric standards for measurement, reliability, validity, interpretability, item relevance, and burden recommended for Health related Quality of Life instruments, and, although responsiveness could not be evaluated, this has been repeatedly demonstrated in other studies in patients with either angina or ischemic heart failure.

This study extends previous international validation studies in other languages in patients with angina, MI, and ischemic heart failure, substantiating the suggesting of the MacNew as a potential core IHD-specific Health related Quality of Life instrument.

Stefan hofer 2008

Patient-reported outcomes, such as HRQL questionnaires, are important when identifying the effects of CHD and evaluating the efficacy of treatment .There are two main types of HRQL questionnaires: generic HRQL questionnaires, which are used to evaluate HRQL in different populations, and specific HRQL questionnaires, which are used to evaluate HRQL in patients with specific conditions and are claimed to be more responsive, as they include items relevant to the designated patient population .

The MacNew Heart Disease HRQL Questionnaire (MacNew), with items relevant to patients with angina, is a self-administered disease-specific HRQL questionnaire. It was originally developed and validated for patients with myocardial infarction (MI) , and since has been validated in patients with angina ,acute coronary syndrome and heart failure .

Benzer W 2004

The Turkish version of the MacNew generally satisfied the criteria for construct validity. The MacNew items are focused on how the patient feels after the event, whereas the SF-36 items tend to address the issue of how the patient is doing or performing since the event. As noted previously , this may help explain some of the higher-than-expected correlations we observed between dissimilar SF-36 and MacNew constructs in these Turkish patients with angina. Patients with improved health status and those who were neither anxious nor depressed had significantly higher Mac-New scores than patients with a deteriorated health status, anxiety or depression, which is consistent with previous reports of the psychometric properties of the MacNew.

Heller 1996

The MacNew HRQL Questionnaire, designed to assess patients' feelings about how heart disease affects daily physical activities and emotional and social functioning, has a 2-week timeframe and consists of 27 items, which fall into three domains (physical limitations, emotional and social function) with a global HRQL

score. The MacNew has been translated into more than 20 languages, and was translated using accepted translation strategies into Turkish for the study.

Parreria 2010

Literatures have found that younger patients had lower postoperative vital capacity than older, further it was hypothesized that males had lower postoperative inspiratory capacity than females. It was detailed that the young patients normally use a greater amount of motion in the thorax while breathing when compared to the older.

Kenji Ueshima 2004

The study suggested that changes in the subjective and social index contribute to an exercise training-related improvement in the quality of life. In other words, exercise training may favourably affect the mental and spiritual well- being of the patient. The cardiac rehabilitation should be applied based on the concept of a long-term comprehensive program consisting not only of exercise training but also education and counselling. Efficient comprehensive rehabilitation for patients for whom it is indicated may be effective.

Constantina Lomi 2013

The author found deep breathing was the first choice of breathing technique, and this is in agreement with previous studies. Incentive Spirometry was the second most frequently used breathing technique.

The incentive Spirometry device is often recommended postoperatively but has not been proven to show effect after cardiac surgery. The use of breathing exercises with positive expiratory pressure (PEP) devices has been described as being extensively used in clinical practice postoperatively in Sweden and Brazil despite the lack of evidence of benefit compared with that for conventional deep breathing exercises.

Rajan Modi 2014

A structured inpatient physiotherapy program is considered beneficial in improving the walking capacity, besides other parameters in subjects undergoing open heart surgery.

Moderate intensity exercises helps in secondary prevention of the cardiac issues besides managing them. The regular endurance physical activity in patients with acute coronary syndrome helps in declining the mortality rate, and also serves in improving the overall physical functioning of the patients.

Dorival Julio Della Togna, et al 2013

The study concludes the limitations and difficulties of adequately quantifying functional class, especially in sedentary individuals, suggest the need for a more accurate assessment. It is likely that the reduction in Oxygen Uptake Efficacy Slope and VO2 observed seven months after surgery occurred due to physical deconditioning and lack of training of patients in rehabilitation programs.

Brunner H., 2005.

Aerobic capacity has been found to be the single best parameter of cardiac function and al cause of death among known case of CVD. It is measured directly as peak VO_2. The improvement of the peak VO_2 can improve aerobic capacity and cardiac rehabilitation. Moreover, reduction of the most common traditional risk factors for CVD can decrease the occurrence of cardiovascular events. Research suggests that CAD and associated with impaired endothelial dysfunction, which is evaluated by flow -mediated dilation and can be improved through physical exercise.

III METHODOLOGY

3.1 STUDY DESIGN

- Pre-test and Post-test experimental study design.

3.2 STUDY SETTING

- The study was conducted in the Department of Cardio-Thoracic Surgery and Department of Physiotherapy, K.G. Hospital, Coimbatore.

3.3 STUDY DURATION

- The study was conducted over a period of six months. Each patient underwent treatment for the duration of 4 weeks.
- Frequency : Five days / week.
- Duration : 30-40 minutes / session.

3.4 STUDY SAMPLES

The sample size was determined based on a pilot study. Ten patients were divided randomly into two equal groups, and the main part of the study was conducted on them. The mean and standard deviation (SDs) for the parameters from this pilot study, with $\alpha = 0.05$ and 90% power, were used to calculate the sample size.

A total of 30 patients were selected based on the selection criteria and divided into two groups. Each group consisted of (n=15) members. The sample selection was done using random sampling method. The informed written consent was obtained

from the patients after explaining the purpose and procedure of the study in the language they understood best.

3.5 CRITERIA FOR SELECTION

3.5.1 INCLUSION CRITERIA

- Age of 40-60 years
- Only males were included for the study.
- Only CABG patients were included.
- Patients with LVEF (left ventricular ejection fraction) >45 %
- Patients willing to do exercise.
- Patients were taken only from 7^{th} post operative day.
- Patients referred to the study by cardiothoracic surgeon.

3.5.2 EXCLUSION CRITERIA

- Age below 40 and above 60.
- Females were excluded.
- Percutaneous transluminal coronary angioplasty patients.
- Complicated and readmitted to ICU
- Valvular diseases.
- Cardiomyopathy patients.
- Left ventricular dysfunction/ Pulmonary hypertension.

- Patients with renal problem.
- Patients with respiratory problems.
- Patients with lower limb injuries.
- Patients with any type of infections.

3.6 VARIABLES

3.6.1 INDEPENDENT VARIABLES

- Aerobic interval Training
- Conventional cardiac rehabilitation.

3.6.2 DEPENDENT VARIABLES

- Endurance Capacity
- Quality of Life

3.7 OPERATIONAL TOOLS

- Six Minute Walk Test
- MacNew Questionnaire

3.8 PROCEDURE

After coronary revascularization, patient was shifted from cardiac ICU to cardiac inpatient unit on third postoperative day. All the patients were assessed by cardiothoracic surgeons and stated to be haemodynamically stable and recommended for cardiac rehabilitation.

Based on the inclusion criteria and willingness of patients, the subjects were recruited for the study. Approximately 60 surgeries were done in the period of study. The patients were recruited with the prescription from the cardiac surgeon and a clear assessment was done to find the suitable participants in this study.

The patients were divided into 2 groups by simple random sampling method, each group consist of 15 patients after Coronary Revascularization. A clear instruction was given to all the patients who signed up for the study, written consent was obtained from every individual patient. Instruction about the exercises, beneficial effect of the exercises, demerits of exercises were told to the patients, log book use was instructed to the patient and invited them to visit the OPD (physiotherapy department) during their next visit with the doctor.

Six minute walk test was instructed and asked them to perform in the hospital corridor with the markings over the floor and MacNew questionnaire was given to them and asked to fill-up the questionnaire, some assistance was provided by the team of physiotherapy during the questionnaire fill-up. The collected data were kept confidentially and taken for the analysis.

GROUP-A

- Patients in this group underwent Conventional Cardiac rehabilitation as described by Renu B. Pattanshetty 2014, the exercises and the protocols elaborated in the appendix.

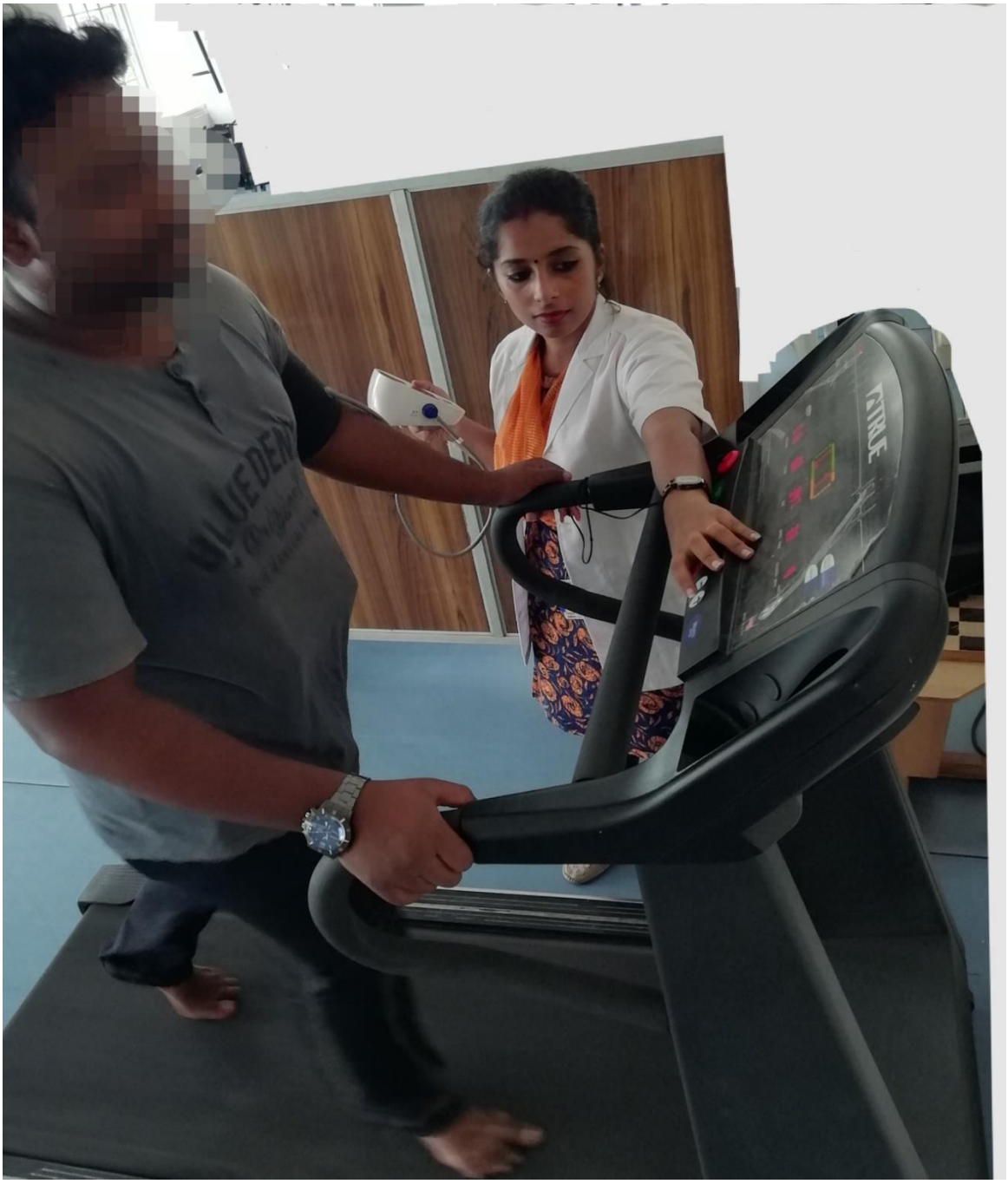
CONVENTIONAL CARDIAC REHABLITATION

- Diaphragmatic breathing exercise
- Upper and Lower Limb Exercises
- Stair climbing Activities (Ref Appendix).

GROUP- B

- Patients in this group underwent Aerobic interval training used in Trine T. Moholdt 2009 study along with conventional physiotherapy.
- The aerobic interval training program consisted of treadmill walking. Aerobic interval training consist of 8 minutes of warm up, followed by 4 times of 4 minute intervals with heart rate at 90% of maximum heart rate, with active pause of 3 minutes of walking at 70% of maximum heart rate.
- The exercise session was terminated by 5 minute cool down period.
- The intensities were controlled by heart rate monitor (Polar elctro, kempele, Finland).
- Conventional cardiac rehabilitation were given as per in group - A .

AEROBIC INTERVAL TRAINING



3.9 STATISTICAL TOOLS

The following statistical tools were used to analyze patients. The Paired 't' test was used to compare the pre and post test values for Group A & B.

Formula: Paired 't'-test

$$S=\sqrt{\frac{\sum d^2-\frac{\sum_{d^2}}{n}}{n-1}}$$

$$t=\frac{\bar{d}\sqrt{n}}{s}$$

Where,

d = difference between the pre-test versus post test

$\bar{d}$ = mean difference

n = total number of subjects

s = standard deviation

$\sum d^2$ = sum of the squared deviation

Formula of unpaired 't' test:

The unpaired ‘t’ test was used to explore the gait competency between Group - A and Group - B.

$$S = \sqrt{\frac{\sum(x_{1-\overline{x_2}})^2 + (x_2 - \bar{x}_2)^2}{n_{1+}n_2 - 2}}$$

$$T = \frac{\overline{x_1} - \overline{x_2}}{S} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where,

n_1 = total number of subjects in Group - A

n_2 = total number of subjects in Group - B

x_1 =difference between pre-test versus post-test of Group - A

$\overline{x_1}$ =mean of Group - A

x_2=difference between pre-test versus post-test of Group - B

$\overline{x_2}$ = mean of Group - B

S = Standard deviation

LEVEL OF SIGNIFICANCE – 5%

IV DATA ANALYSIS AND INTERPRETATION

TABLE- I

GROUP - A- CONVENTIONAL CARDIAC REHABILITATION

SIX MINUTE WALK TEST

PAIRED 't' TEST

S.NO	TEST	MEAN	MEAN DIFFRENCE	STANDARD DEVIATION	't' VALUE
1.	PRE-TEST	250.86	57.07	3.481	16.39
2.	POST-TEST	307.93			

The comparison of pre-test and post-test values of Six Minute Walk Test for Group – A showed that the calculated ‘t’ value 16.39 is significantly greater than the tabulated ‘t’ value 2.145 at 5% level of significance. This shows that there is a significant improvement in Endurance Capacity following Conventional cardiac rehabilitation.

GRAPH- I

GROUP - A- CONVENTIONAL CARDIAC REHABILITATION

SIX MINUTE WALK TEST

PAIRED 't' TEST

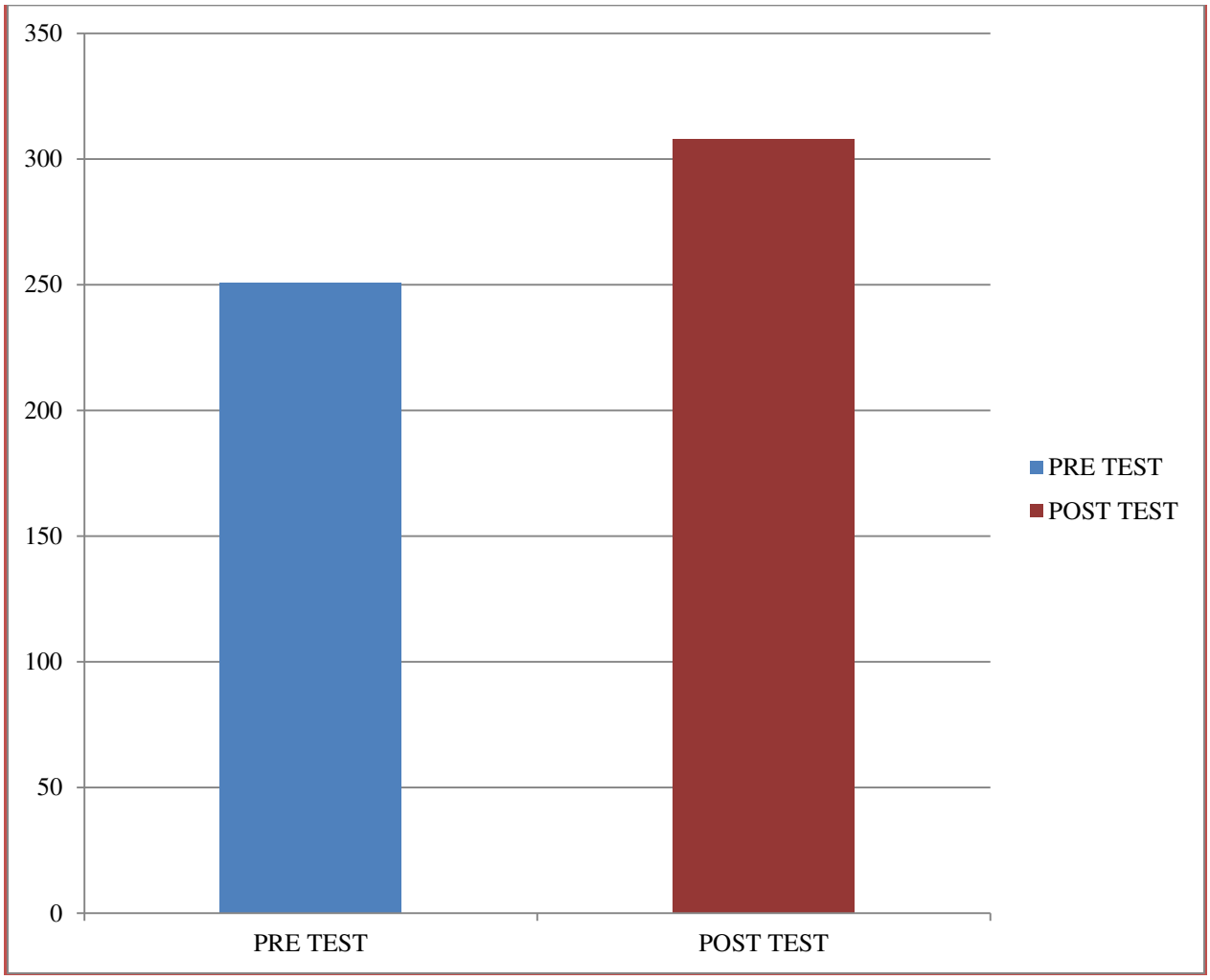


TABLE-II

GROUP - B-AEROBIC INTERVAL TRAINING WITH CONVENTIONAL CARDIAC REHABILITATION

SIX MINUTES WALK TEST

PAIRED‘t’ TEST

S.NO	TEST	MEAN	MEAN DIFFRENCE	STANDARD DEVIATION	't' VALUE
1.	PRE-TEST	256.46	113.87	5.802	19.62
2.	POST-TEST	370.33			

The comparison of pre-test and post-test values of Six Minute Walk Test for Group – B showed that the calculated ‘t’ value is 19.62 significantly greater than the tabulated ‘t’ value 2.145 at 5% level of significance. This shows that there is a significant improvement in Endurance Capacity following aerobic interval training along with Conventional cardiac rehabilitation.

GRAPH -II

GROUP - B-AEROBIC INTERVAL TRAINING WITH CONVENTIONAL CARDIAC REHABILITATION

SIX MINUTES WALK TEST

PAIRED‘t’ TEST

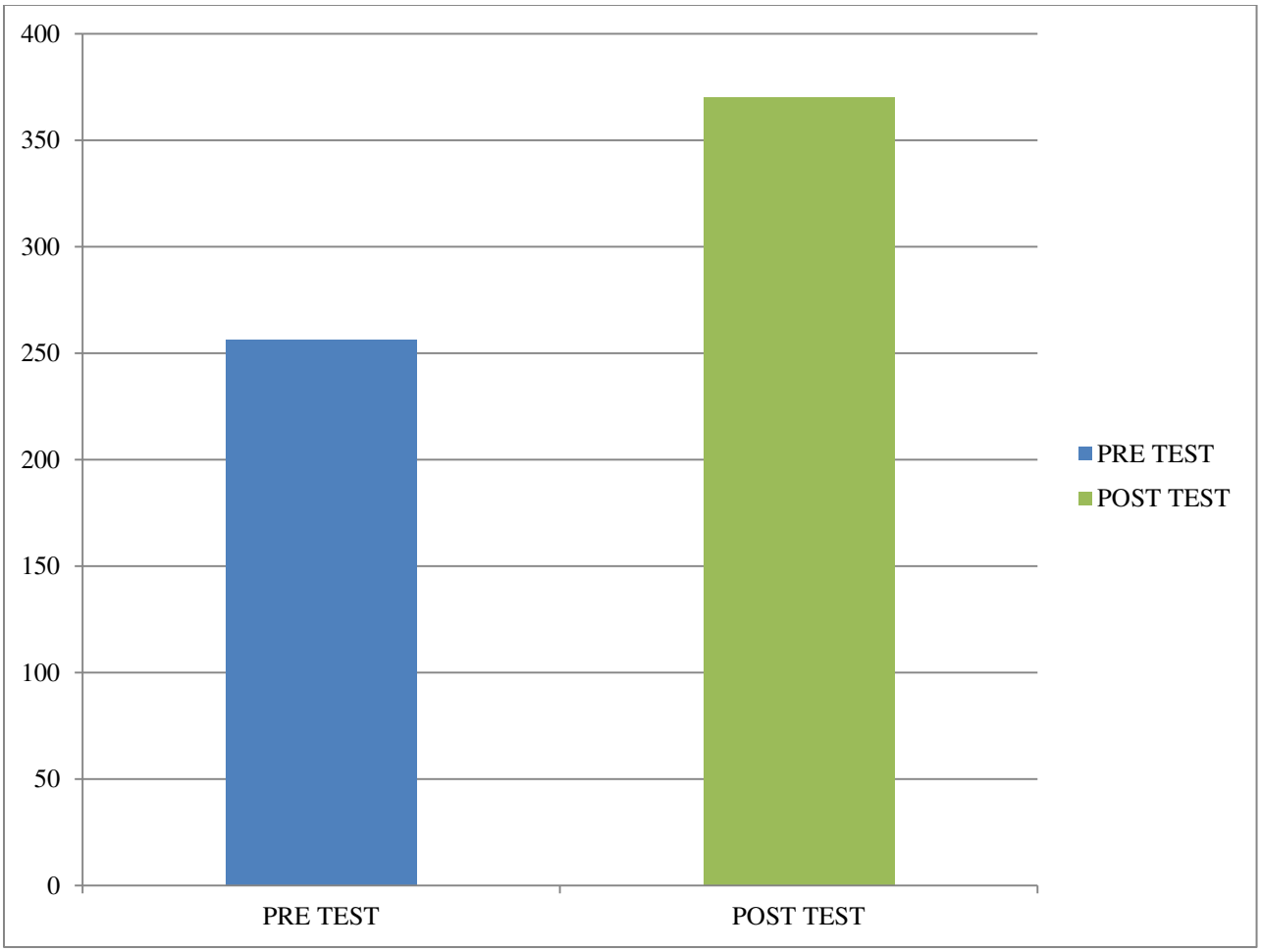


TABLE- III

GROUP - A vs GROUP - B

SIX MINUTE WALK TEST

UNPAIRED‘t’ TEST

S.NO	TEST	MEAN	MEAN DIFFRENCE	STANDARD DEVIATION	't' VALUE
1.	GROUP - A	307.93	62.4	6.33	9.84
2.	GROUP - B	370.33			

The comparison of post-test values of Six Minute Walk Test between Group – A and Group - B showed that the calculated‘t’ value 9.84 is significantly greater than the tabulated t value 2.048 at 5% level of significance. This shows that there is a significant improvement on Endurance Capacity in Group B than Group A following treatment.

GRAPH- III

GROUP A vs GROUP B

SIX MINUTE WALK TEST

UNPAIRED‘t’ TEST

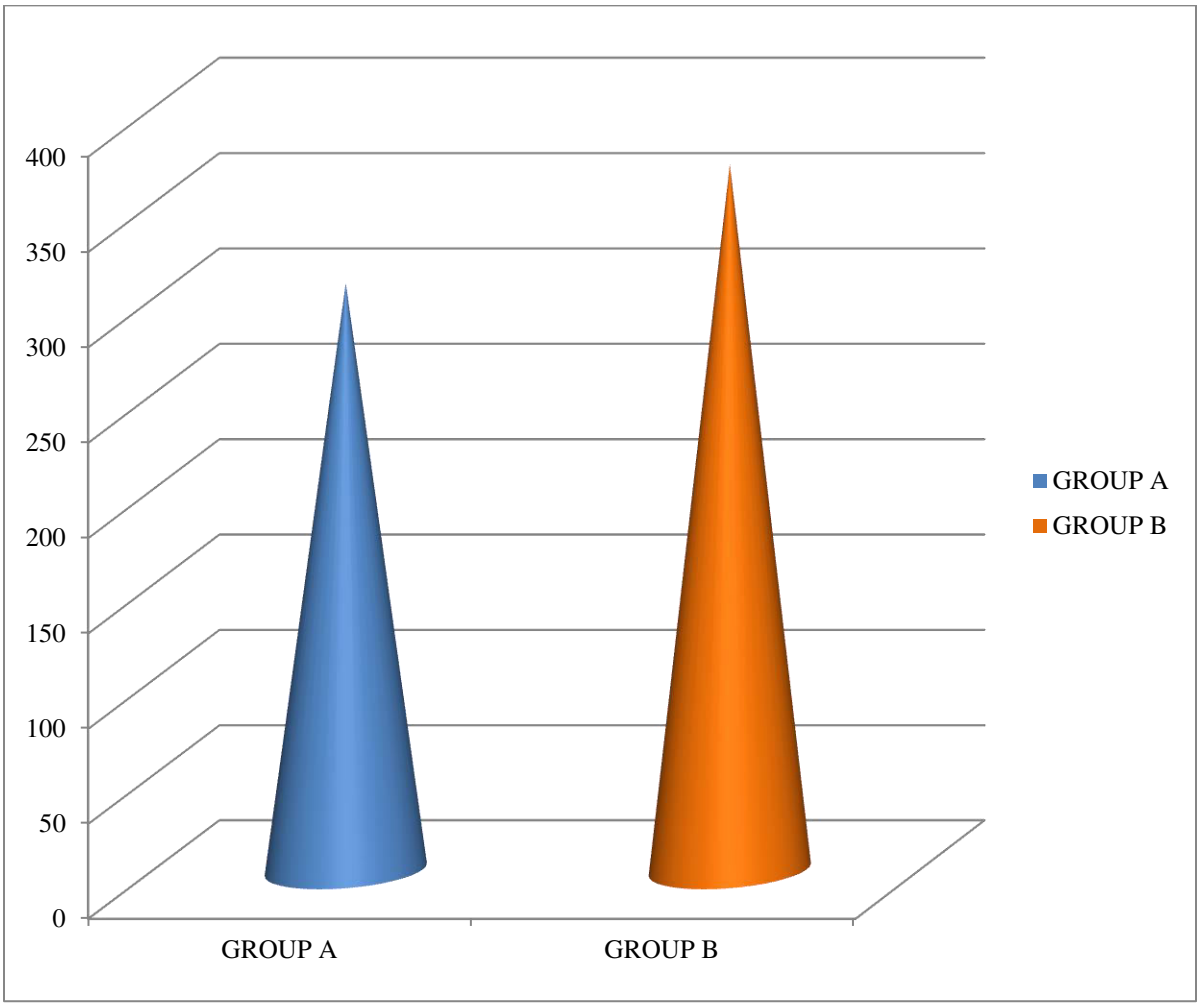


TABLE –IV

GROUP –A - CONVENTIONAL CARDIAC REHABILITATION

MACNEW QUESTIONNAIRE

PAIRED‘t’ TEST

S.NO	TEST	MEAN	MEAN DIFFRENCE	STANDARD DEVIATION	't' VALUE
1.	PRE -TEST	34.4	103.73	1.5	66.89
2.	POST-TEST	138.13			

The comparison of pre-test and post-test values of MacNew Questionnaire for Group - A showed that the calculated ‘t’ value is 66.89 is significantly greater than the tabulated ‘t’ value 2.145 at 5% level of significance. This shows that there is a significant improvement in Quality of Life following Conventional cardiac rehabilitation alone.

GRAPH –IV

GROUP –A- CONVENTIONAL CARDIAC REHABILITATION

MACNEW QUESTIONNAIRE

PAIRED‘t’ TEST

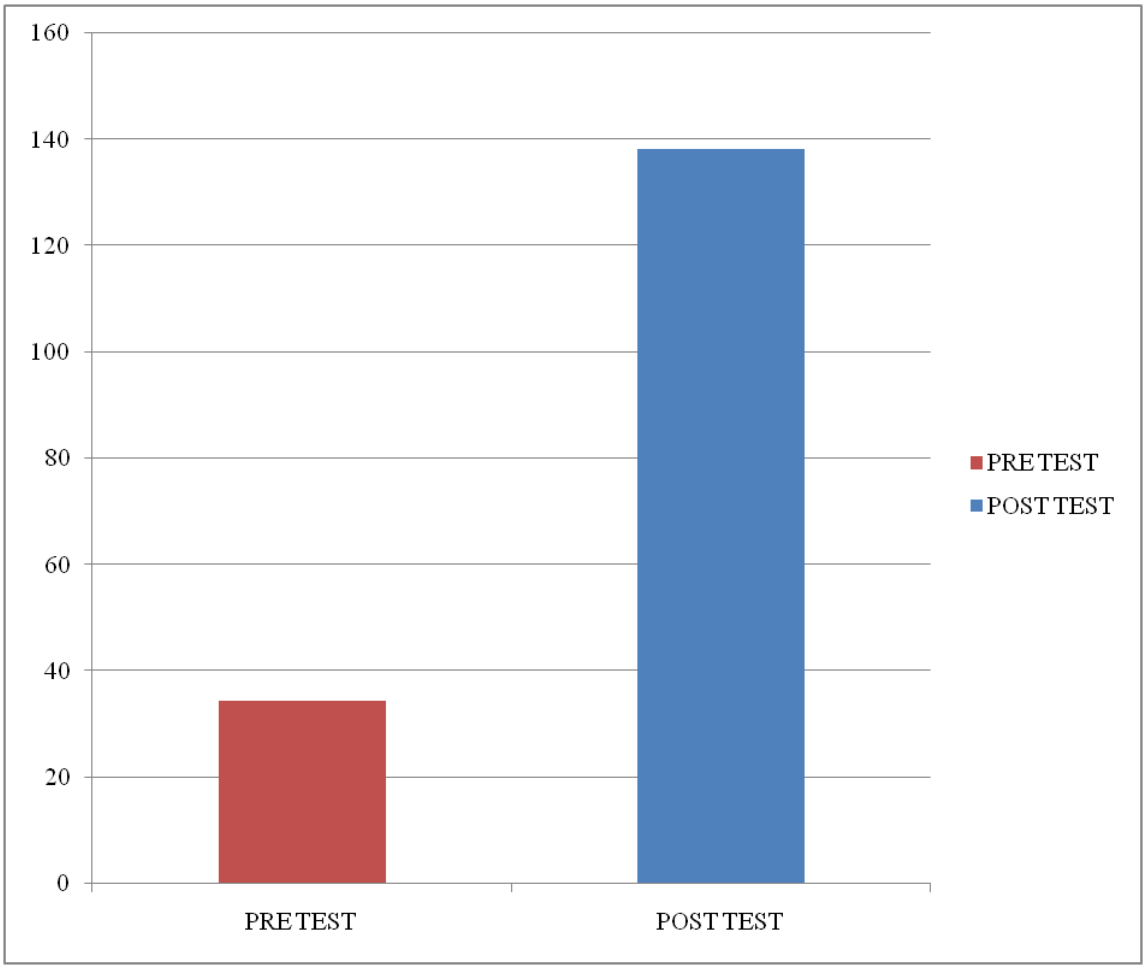


TABLE-V

GROUP - B-AEROBIC INTERVAL TRAINING WITH CONVENTIONAL CARDIAC REHABILITATION

MacNew QUESTIONNAIRRE

PAIRED‘t’ TEST

S.NO	TEST	MEAN	MEAN DIFFRENCE	STANDARD DEVIATION	't' VALUE
1.	PRE - TEST	35.2	132.1	1.47	89.79
2.	POST-TEST	167.3			

The comparison of pre-test and post-test values of MacNew Questionnaire for Group - B showed that the calculated ‘t’ value is 89.79 is significantly greater than the tabulated ‘t’ value 2.145 at 5% level of significance. This shows that there is a significant improvement in Quality of Life following Aerobic interval training along with Conventional cardiac rehabilitation.

GRAPH –V

GROUP – B - AEROBIC INTERVAL TRAINING WITHCONVENTIONAL CARDIAC REHABILITATION

MACNEW QUESTIONNAIRE

PAIRED‘t’ TEST

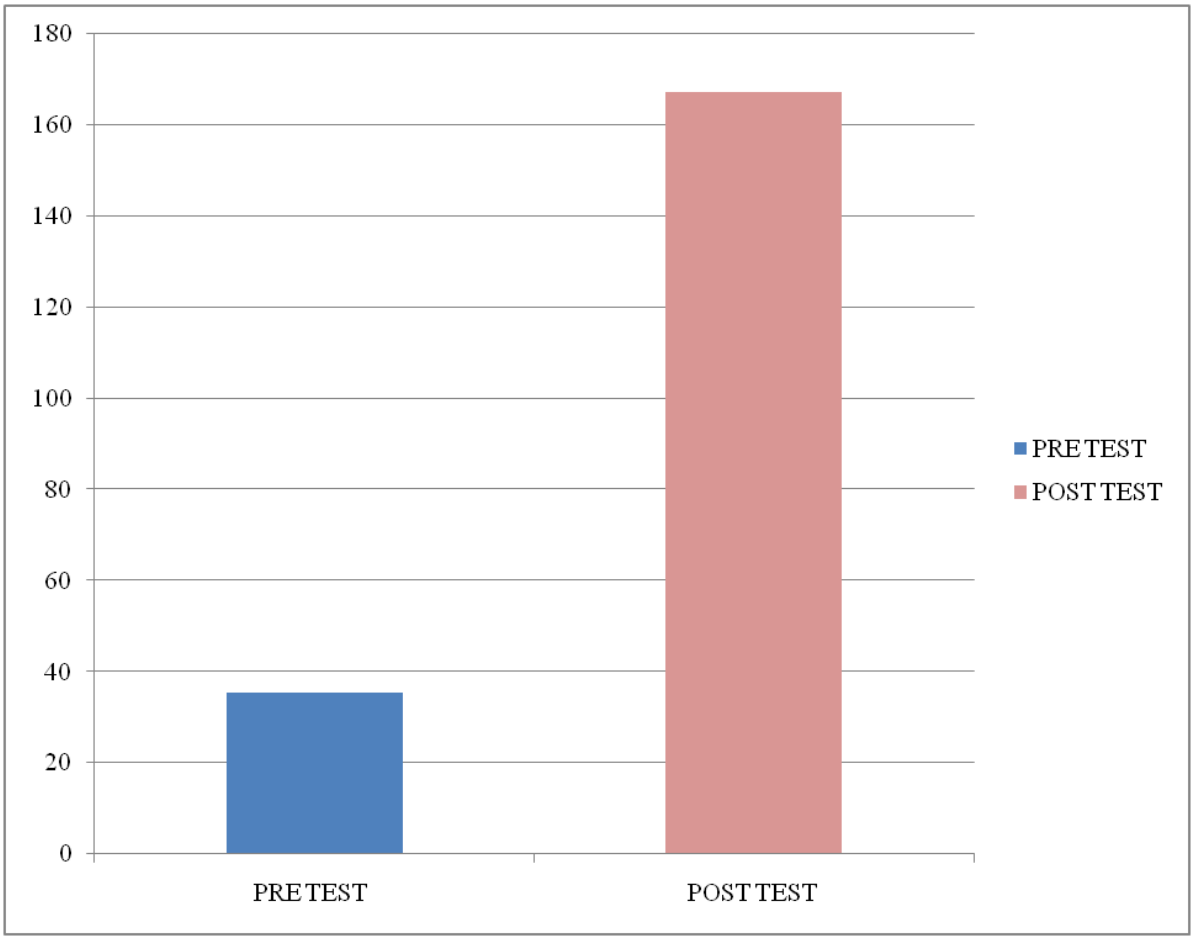


TABLE- VI

GROUP - A vs GROUP - B

MACNEW QUESTIONNAIRE

UNPAIRED‘t’ TEST

S.NO	TEST	MEAN	MEAN DIFFRENCE	STANDARD DEVIATION	't' VALUE
1.	GROUP - A	138.13	29.17	1.83	15.89
2.	GROUP - B	167.3			

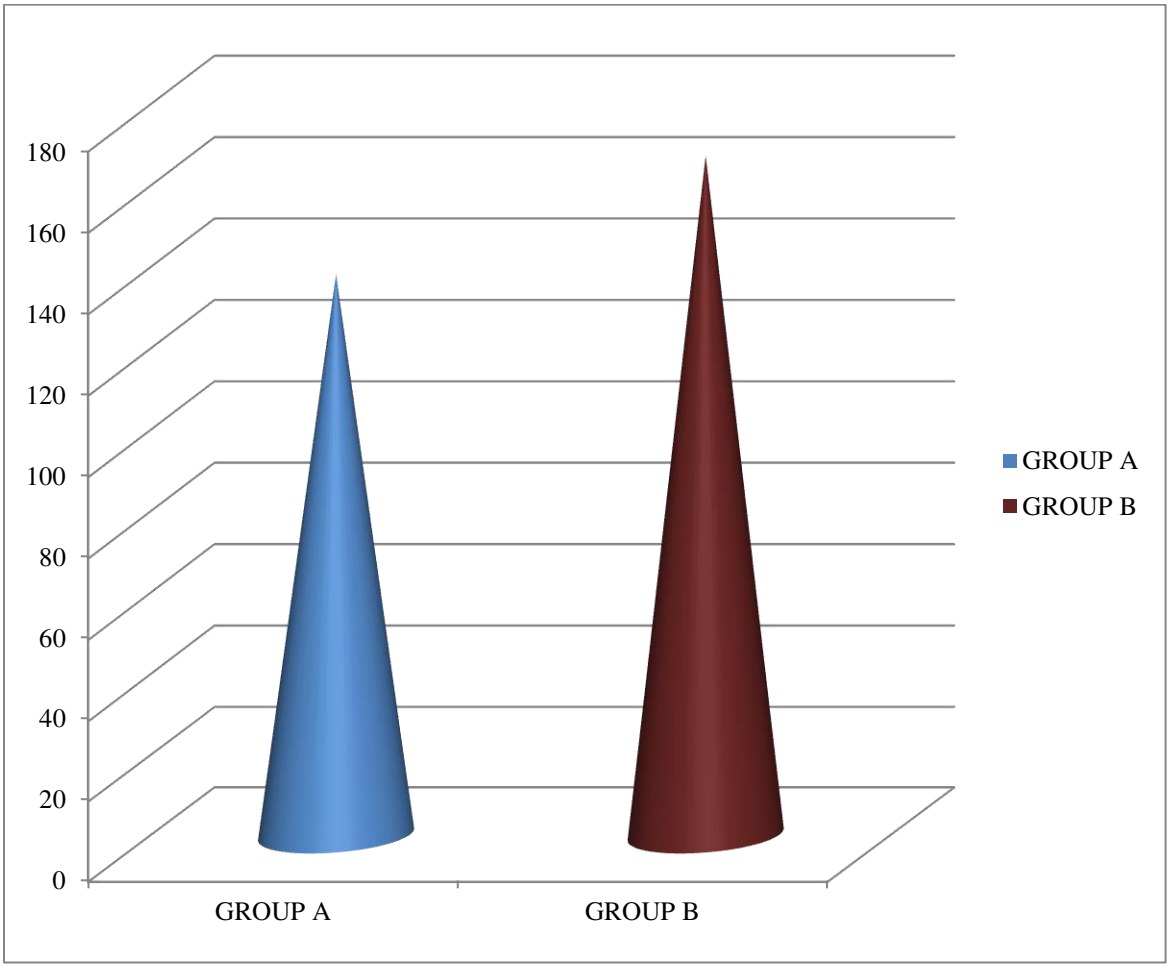
The comparison of post-test values of MacNew questionnaire between Group - A and Group - B showed that the calculated‘t’ value 15.89 is significantly greater than the tabulated ‘t’ value 2.048 at 5% level of significance. This shows that there is a significant improvement on Quality of Life in Group B than Group - A after following treatment.

GRAPH- VI

GROUP - A vs GROUP - B

MACNEW QUESTIONNAIRE

UNPAIRED‘t’ TEST



V RESULT

30 subjects after Coronary Revascularization were selected according to inclusive and exclusive criteria and randomly divided into two groups with 15 subjects in each group (Group - A and Group - B). Age group of the participants varies from 40 years to 40-60 years. Treatment duration was 4 weeks.

The Paired ‘t’ test analyses for the pre test and post test variable of six minute walk test for the Group - A and Group - B patients after Coronary Revascularization which was shown in table I and II. Both the groups show significant differences in the pre test and post test values. The 't' value for the Group - A is 16.39 and the 't' value for the Group - B is 19.62. The unpaired 't' test analysis for the post-test variables of both group for the six minute walk test for measuring endurance capacity in patients is shown in the table III. There was a significant difference shown between the Groups. Subjects in Group - A showed fewer improvements as that of Group - B. The unpaired‘t’ value for the post test variables for both groups is 9.84.

The Paired ‘t’ test analyses for the pre test and post test variable for the MacNew questionnaire for measuring quality of life in patients after Coronary Revascularization which was shown in table IV and V. Both the groups show significant differences in the pre test and post test values. The 't' value for the

Group A is 66.89 the ‘t’ value for the Group B is 89.79. The unpaired‘t’ test analysis for the post test variables for the both group for quality of life in patients after coronary revascularization is shown in the table VI. There was a significant difference shown between the Groups. Subjects in Group – A showed improvements comparatively less as that of Group - B. The ‘t’ value for the post test variables for both groups is15.89.

The statistical analysis revealed that there was statistically significant improvement in the endurance capacity and health related quality of life in both the groups, but there is a significant improvement in the endurance capacity and quality of life in the Group - B than Group - A.

VI DISCUSSION

The aim of the study is to identify the effect of aerobic interval training with conventional cardiac rehabilitation on the endurance capacity and quality of life after coronary revascularization. 30 patients were selected after Coronary Revascularization for the study and they were included with two treatment groups. This study focused on assessing the efficacy of Aerobic interval training on endurance capacity and quality of life after Coronary Revascularization.

After reviewing the literature and knowing disadvantages of anaesthesia, median sternotomy, prolong immobilization after Coronary Revascularization and insertion of thoracic and mediastinal drainage tubes, majority of these patients present a restrictive disturbance with reductions in the pulmonary volumes, pressures and capacities. Therefore, cardiac rehabilitation should be focused on restoring the pulmonary function as early as possible and improve overall functional and psychological status of the patient (Hannan 2003). Cardiac rehabilitation program is prescribed to avoid inactivity and to maintain and improve pulmonary capacities and muscular strength especially in patients after cardiac surgery (Pryor 2002).

A systematic review was carried out to determine the efficacy of the use of physiotherapy in the prevention of pulmonary complications in post-operative cardiac surgery patients.

However, it was well accepted from the systematic review that patients who have undergone cardiothoracic surgery definitely need special attention directed towards the ventilatory function (Pasquina 2003).

The variability in pain relief in post-operative patients is been influenced by their perception of pain. Patients may underestimate their pain due to their knowledge that it is natural to have pain after any surgical procedure despite which pain builds in character and plays a purposeful role in recovery.

In this study the subjects in Group - A, underwent conventional cardiac rehabilitation program through a set of protocol which was followed by department of cardio thoracic surgery, K.G hospital. The subjects in Group - B underwent aerobic interval training along with conventional cardiac rehabilitation program. All the subjects in both the group underwent 4 week program. Following the treatment, their pre test values and post test values were calculated and analyzed for the results.

Aerobic interval training has been demonstrated to activate p38 mitrogen-activated protein kinase and 5'-adenosine monophosphate-activated protein kinase. Exercise responsive signaling kinases are implicated in direct phosphorylation and activation of PGC-1α . Increased nuclear abundance of PGC-α following interval training may co activate transcription factors to increase mitochondrial gene transcription, ultimately resulting in accumulation of more mitochondrial proteins to drive mitochondrial biogenesis. (Bin Xie 2017)

Mitochondrial biogenesis is essential to maintain the structural integrity of skeletal muscle. Mitochondrial function is associated with aerobic physical fitness and plays an important pathophysiological role in cardiac patients. (Jilin Li 2017)

It is important to mention that the respiratory physiotherapy promotes recovery of lung function after cardiac surgery, since it leads to increased alveolar recruitment, increase in FRC and improves the diffusion capacity (Brasher et al., 2003, Jenkins et al., 1989).

Diaphragmatic breathing exercise are easy to perform, it helps to increased oxygenation immediately after 2^{nd} post operative day of cardiac surgery (Westerdahl et al., 2003). Changes in muscle activity of diaphragm were shown to improve respiratory ability because of its synergy effect while these two muscles are doing inhalation (Kang 2016).

The high-intensity exercise in the AIT group was set to 90% of Hf_{max} and was performed as AIT because this training method has previously yielded the greatest improvements in aerobic capacity over a relatively short time in healthy individuals, and in patients with coronary artery disease, intermittent claudication the metabolic syndrome and post-infarction heart failure . The rationale behind interval training is that most evidence suggests that it is the pumping capacity of the heart (i.e. stroke volume) that limits, Vo2max, and the interval design allows for rest periods that make it possible for the adolescents to complete short work

periods at higher intensities, which thereby challenge the heart's pumping ability more than what would be possible by continuous exercise.(marte volden 2009).

Respiratory training improves the functional capacity which was evaluated by using Six minute walk test and the quality of life which was evaluated using the MacNew questionnaire.

The MacNew Heart Disease HRQL Questionnaire (MacNew), with items relevant to patients with angina, is a self-administered disease-specific HRQL questionnaire. It was originally developed and validated for patients with myocardial infarction (MI) , and since has been validated in patients with angina acute coronary syndrome and heart failure. (stefan hofer 2008)

The present study safely concludes that Aerobic interval training when added to conventional cardiac rehabilitation proved to be significantly effective in increasing the endurance capacity, thereby improving quality of life in phase II cardiac rehabilitation program in patients who underwent median sternotomy for Coronary Revascularization procedure.

VII SUMMARY AND CONCLUSION

SUMMARY

The purpose of the study is to find out the effect of analyze the efficacy of aerobic interval training Comparing with Conventional cardiac rehabilitation on Improving endurance capacity and Quality of Life after Coronary Revascularization.

30 patients after Coronary Revascularization were selected randomly for the study. All the participants were assessed for hemodynamic stability by a cardiac surgeon and were assessed by the clinical physiotherapist prior to the recruitment. All the participants were recruited based on the selection criteria. A clear explanation was given to every individual subjects and those who were selected and randomly assigned into two equal groups. Written consent was obtained from all the participants.

Group - A (control group) participants underwent conventional cardiac rehabilitation based on exercise protocol used on follow up period, for duration of 4 weeks and to maintain mobility. Group - B (experimental group) was given aerobic interval training (treadmill walk), parameters are based on a set of treatment protocol. Following the treatment, their pre-test values and the post test values were calculated and analyzed for the results.

The results were analyzed using tools of measurement of Six Minute Walk Test and MacNew Questionnaire. The data was collected, the results were tabulated and the outcome was analyzed using paired and unpaired test.

Student‘t’ test was used to find the difference between the pre-test and post test outcomes as well as the difference between the two groups. Results of Group - A and Group - B, post-test values showed that calculated‘t’ value is greater than critical value using Six Minute Walk Test and the Quality of life.

Based on this statistical analysis the Group - B participants show a marked improvement in the six minute walk test and the quality of life questionnaire when compared to Group - A participants.

Therefore, this study strongly suggests that aerobic interval training when added to conventional cardiac rehabilitation proved to be significantly effective in improving endurance capacity and quality of life as compared to conventional cardiac rehabilitation alone after Coronary Revascularization.

CONCLUSION

- There is a significant improvement of 6 minute walk test. in both the groups.
- There is a significant improvement of Quality of life in both the groups.
- When compared to Group - A (Control group), the Group - B (Experimental group) shows a marked improvement of 6 minute walk test.
- When compared to Group - A (Control group), the Group - B (Experimental group) shows a marked improvement of Quality of life.

So this study concluded that aerobic interval training when added to conventional physiotherapy program proved to be significantly effective in improving endurance capacity and quality of life as compared to conventional cardiac rehabilitation alone after Coronary Revascularization.

VIII LIMITATIONS AND RECOMENDATIONS

LIMITATIONS

- High risk subjective was not included such heart failure, systemic hypertensive patients etc.
- Small sample size and study duration.
- Only males were included.
- It is also important that the study was not an "intension to treat the study" but "rather an affect of treatment study"
- In this caloric expenditure was not measured.
- Only patients after coronary revascularization were taken.

RECOMMENDATIONS

- Respiratory muscle strength should be assessed pre and post operatively as routine clinical examination to prevent post-operative pulmonary complication.
- Larger sample can be added.
- The measurements of caloric expenditure can be measured.
- Different parameters can be included for the further study regarding aerobic interval training such as VO_2 max with Borg scale.

- Warm up exercises can be included in further study.
- Aerobic interval training can be used as preventive training for overweight adolescents to reduce cardiovascular risk factors.
- SF-36 can also be used for quality of life measurement.

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X APPENDIX

APPENDIX – I

CARDIOPULMONARY ASSESSMENT FORMAT

DEMOGRAPHIC DATA

Name: Room no.:

Age:

Sex:

Date of admission:

Date of surgery:

Name of surgery:

Date of assessment:

Chief complaints**:**

HISTORY

Past medical history:

Present medical and surgical history:

Personal history:

Family history:

Drug history:

Social history:

Associated problems:

PHYSICAL EXAMINATION

VITAL SIGNS

- Temperature
- Pulse

- Respiratory rate
- SpO2
- Blood pressure (BP)

SUBJECTIVE ASSESSMENT

- Pain assessment
- Dyspnea assessment
- Cough assessment

OBJECTIVE ASSESSMENT

ON OBSERVATION

- Built:
- Posture:
- Gait:
- Deformity:
- Chest shape:
- Chest symmetry:
- Breathing pattern:
- Clubbing :
- Cyanosis:
- Edema:
- breathing pattern:
- Usage of accessory muscle:

ON PALPATION

- Tracheal deviation:
- Tenderness on accessory muscles:
- Tenderness:
- Edema:

ON EXAMINATION

Symmetry of chest

Chest expansion

- Axillary level
- Nipple level
- Xiphoid level

ON AUSCULTATION

- Heart sound
- Breath sound
- Added sound

INVESTIGATION:

DIAGNOSIS:

TREATMENT:

APPENDIX II

CONVENTIONAL CARDIAC REHABILITATION PROGRAM

METS	CARDIAC REHABILITATION EXERCISES	ACTIVITY
1 - 1.5 (LEVEL 1)	Sitting with feet supported. Active assisted range of motion exercises to major muscle groups of upper limbs. Active ankle exercises. Active scapular elevation and depression. Frequency of 3-5 repetitions for all exercises, once a day. Deep breathing exercises like diaphragmatic, pursed lip breathing, thoracic expansion exercises. Incentive Spirometry exercises Breathing exercises every two to three hourly - 10 Repetitions	Begin sitting in chair with support several times per day for 10-30 minutes. Monitored ambulation 100-200 feet with assistance, once or twice daily.
1.5 – 2 (LEVEL 2)	Active range of motion exercises to major muscle groups of upper limbs. Active ankle and knee exercises. Active scapular elevation and depression. Frequency increased to 5-10 repetitions, twice a day. Breathing exercises same as above.	Same as above. Increase ambulation to 300feet or Approximately 3 corridor lengths at a slow pace with assistance and slowly progress
2 - 2.5 (LEVEL 3)	Active range of motion exercises to major muscle groups of upper limbs. Active ankle and knee exercises. Active scapular elevation and depression. Standing leg exercises optional Breathing exercises same as above. Frequency increased to 15 repetitions, twice a day	Room or hall ambulation up to 5-10 min as tolerated 3-4 times/day (424-848 feet). Bathroom/privileges Independent/assisted ambulation in room or hall

		As advised by The Physiotherapist (PT)
2.5 - 3 (LEVEL 4)	Same as above. Standing trunk exercises optional	Hall ambulation up to 10-15 min as tolerated 3-4 times/day (3000 feet

3 – 4 (LEVEL 5)	All exercises same as above	Hall ambulation increased as tolerated by the patient
4 – 5 (LEVEL 6)	All exercises same as above. Home exercise program explained	Progressive-hall ambulation as tolerated by the patient. Full flight of stairs – once up and down with one step at a time.

APPENDIX III

PROCEDURE FOR AEROBIC INTERVAL TRAINING

- Patients in this group underwent aerobic interval training used in trondheim and Roros study along with conventional physiotherapy.
- The aerobic interval training program consisted of treadmill walking. Aerobic interval training consist of 8 minutes of warm up, followed by 4 times of 4 minute intervals with heart rate at 90%of maximum heart rate, with active pauses of 3 minutes of walking at 70% of maximum heart rate.
- The exercise session was terminated by 5 minute cool down period.
- The intensities were controlled by by heart rate monitor (Polar elctro, kempele, Finland).
- Conventional cardiac rehabilitation were given as per in Group- A .

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APPENDIX IV
SIX MINUTE WALK TEST

According to the American Thoracic Society Guidelines;

- "The 6MWT is easy to administer, better tolerated, and more reflective of activities of daily living than the other walk tests".
- The 6MWT is a practical simple test that requires a 100-ft hallway but no exercise equipment or advanced training for technicians..
- This test measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 minutes (the 6MWD).
- It evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism.

PROCEDURE:

- Subjects were instructed to walk from one end to the other of a 100 ft, hallway at their own place, while attempting to cover as much ground as possible in the allotted 6 min.
- Therapist encouraged patients with standard statement "you are doing well" or "keep up the good work" but were asked not to use other phrases.
- Patients were allowed to stop and rest during the test, but were instructed to resume walking.
- The therapist should monitor and note symptoms, number of rest taken.

APPENDIX V

MacNew QUESTIONNAIRE

Name:

Ref Dr:

Date:

ID:

Age:

Gender: M/F

We would now like to ask you some questions about how you have been feeling during the last 2 weeks. Please check the box that matches your answer.

1. In general, how much of the time during the last 2 weeks have you felt frustrated, impatient or angry?
    - All off the time
    - Most of the time
    - A good bit of the time
    - Some of the time
    - A little of the time
    - Hardly any of the time
    - None of the time
2. How often during the last 2 weeks have you felt worthless or inadequate?
    - All off the time
    - Most of the time
    - A good bit of the time
    - Some of the time
    - A little of the time
    - Hardly any of the time

- None of the time

3. In the last 2 weeks, how much of the time did you feel very confident and sure that you could deal with your heart problem?

- None of the time
- A little of the time
- Some of the time
- A good bit of the time
- A most of the time
- Almost all of the time
- All of the time

4. In general how much of the time did you feel discouraged or down in the dumps during the last 2 weeks?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

5.How much of the time during the past 2 weeks did you feel relaxed and free of tension**?**

- None of the time
- A little of the time
- Some of the time
- A good bit of the time
- A most of the time
- Almost all of the time
- All of the time

6. How often during the last 2 weeks have you felt worn out or low in energy?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

7. How happy, satisfied, or pleased have you been with your personal life during the last 2 weeks?

- Very dissatisfied, unhappy most of the time
- Generally dissatisfied, unhappy
- Somewhat dissatisfied, unhappy
- Generally satisfied, pleased
- Happy most of the time
- Very happy most of the time
- Extremely happy, could not have been more satisfied or pleased

8. In general, how often during the last 2 weeks have you felt restless, or as if you were having difficulty trying to calm down?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

9. How much shortness of breath have you experienced during the last 2 weeks while doing your day-to-day physical activities?

- Extreme shortness of breath
- Very short of breath
- Quite a bit of shortness of breath
- Moderate shortness of breath
- Some shortness of breath
- A little shortness of breath
- No shortness of breath

10. How often during the last 2 weeks have you felt tearful or like crying?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

11.How often during the last 2 weeks have you felt as if you are more dependent than you were before your heart problem?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- little of the time
- Hardly any of the time
- None of the time

12.How often during the last 2 weeks have you felt that you were unable to do your usual social activities or social activities with your family?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

13.How often during the last 2 weeks have you felt as if others no longer have the same confidence in you as they did before your heart problem?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

14.How often during the last 2 weeks have you experienced chest pain while doing your day-to-day activities?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

15. How often during the last 2 weeks have you felt unsure of yourself or lacking in self-confidence?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

16. How often during the last 2 weeks have you been bothered by aching or tired legs?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

17. During the last 2 weeks, how much have you been limited in doing sports or exercise as a result of your heart problem?

- Extremely limited
- Very limited
- Limited quite a bit
- Moderately limited
- Somewhat limited
- Limited a little
- Not limited at all

18. How often during the last 2 weeks have you felt apprehensive or frightened?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

19. How often during the last 2 weeks have you felt dizzy or lightheaded?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

20. In general, during the last 2 weeks how much have you been restricted or limited as a result of your heart problem?

- Extremely limited
- Very limited
- Limited quite a bit
- Moderately limited
- Somewhat limited
- Limited a little
- Not limited at all

21. How often during the last 2 weeks have you felt unsure as to how much exercise or physical activity you should be doing?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

22. How often during the last 2 weeks have you felt as if your family is being over-protective toward you?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

23. How often during the past 2 weeks have you felt as if you were a burden to others?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

24.How often during the past 2 weeks have you felt excluded from doing things with other people because of your heart problem?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

25.How often during the past 2 weeks have you felt unable to socialize because of your heart problem?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time

26. In general, during the last 2 weeks how much have you been physically restricted or limited as a result of your heart problem?

- Extremely limited
- Very limited
- Limited quite a bit
- Moderately limited
- Somewhat limited
- Limited a little
- Not limited at all

27.How often during the last 2 weeks have you felt your heart problem limited or interfered with sexual intercourse?

- All off the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- Hardly any of the time
- None of the time
- Not applicable

APPENDIX – VII

CONSENT FORM

This is to inform that I named _____ voluntary agree to participate in this study "**EFFICACY OF AEROBIC INTERVAL TRAINING ON IMPROVING ENDURANCE CAPACITY AND QUALITY OF LIFE AFTER CORONARY REVASCULARIZATION ".** I have been explained about the procedures and the risk that would occur during the study.

Participant:

Witness:

Date:

I have explained and defined the procedures to which the subject has consented to participate.

Signature of Participant:

Signature of Researcher:

Date: